The Sony Guide to CCTV

Monitor. Survey. Prevent.

this is not a rehearsal.

SONY

In recent years...

there has been no shortage of innovations in the CCTV industry as public and industry acceptance increase demand. Most visibly, more surveillance cameras have appeared in more public areas than ever before, proving their effectiveness and generating interest in maximising the benefits of operating a surveillance system.

The bewildering choice of different equipment and the desire for practical knowledge in this area demonstrates that, as with most disciplines, a little research into the subject will yield higher quality decisions and an improved cost/benefit ratio. It is intended that this Guide should assist you to ask the right questions and direct you towards the best possible solution.

The generalised use of crime statistics, of which there are many varieties, conceal the fact that every situation is different and requires a tailored approach. Most businesses, for example, take an economic approach to the use of security measures – how much will a system cost and how much loss will it prevent? An often quoted but nevertheless true precept is that businesses, particularly retail, often underestimate the true extent of losses. The importance of conducting a detailed audit and survey before even considering technology cannot be over-emphasised.

Where CCTV is used in town centre schemes, the principal objective is to improve the quality of life for the inhabitants by reducing actual and perceived crime. To be an effective deterrent, a system must provide actual as well as theoretical results and be introduced as one part of an overall crime prevention initiative. Where this "system credibility" has been established, the greatest benefits have been derived.

Included in this Guide are some examples of highly credible surveillance schemes where the users have achieved the maximum benefit from their systems, together with detailed background information on the selection and operation of CCTV. We have also included information about how new technology is offering higher levels of performance in video surveillance than ever before.

Sony Broadcast & Professional Europe

.... Sony gives Newham a clearer picture

Newham District Council has the largest local authority CCTV control room in the UK, monitoring over 200 cameras in the heart of London's East End.

Recently, it has installed additional Sony Trinitron colour video monitors, bringing the total in the system to 73 screens. As well as fighting crime, the system is used for traffic surveillance, including monitoring a new bus lane system, controlling vandalism, general council activity and ensuring local authority response to maintenance problems.

The Newham Control Room is also the first in the country to use facial recognition technology and has recently acquired a Sony Mavica digital camera. The camera is being used in the prevention of doorstep fraud to build up a database of employees for the production of ID cards.

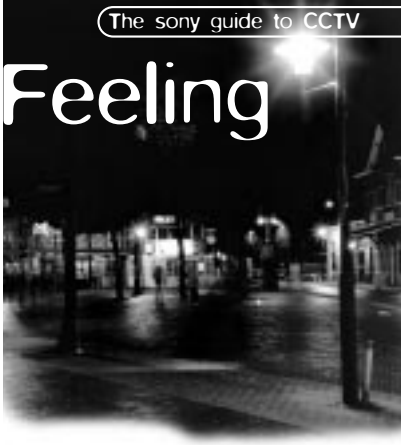
The new colour video monitors – nine SSM-20N5E and two SSM-14N5E – were chosen for their clarity and sharpness of picture – particularly suited to surveillance monitoring.

The Trinitron CRT (Cathode Ray Tube), which has upgraded resolution from a typical 250 to 600 lines, gives a markedly crisper and more stable image. The face of the Trinitron is based on the shape of a cylinder rather than a sphere ensuring that not only is the geometry of the image more accurate, but operator eye-fatigue is reduced.

Operations Manager Bob Lack explains: "The Council has a policy of making the best use of the technology currently available and with the help of optimum funding obtained through the CCTV Challenge scheme and support from local businesses, we have invested £2 million in the last four years".

"We already had 54 Sony SSM-20 and eight SSM-14 monitors in the system, some of which were installed when the control room was first set up five years ago. As the control room monitors are never switched off, durability has also been an important factor."

A Safe Feeling At Night



High Sensitivity Cameras Installed In the Entertainment District of the Dutch city of Ede.

Whether it's raining, snowing, sunny, day or night, a surveillance camera must always produce a perfect picture. That's why Ede's entertainment district has been equipped with Sony CCTV surveillance equipment. But you need more than just technical quality to make a good security circuit.

Local councils and police are doing their utmost, especially at night, to improve safety in town and city centres.

Glass fibre

"Ede has Sony SSC-DC58AP ExwaveHAD video cameras installed, together with Sony SSM-14N5E monitors. Sony has huge experience in the broadcasting world. Any system integrator can tell that for Sony the best is still not good enough. You can clearly see that the picture quality of the Sony cameras is always excellent, even in the worst conditions. That's why it didn't take us long to decide on Sony", said General Manager of integrator VCS International, Wim van Deijzen.

As far as Ede is concerned, the police feel it is vital to have access to top quality pictures, all the time. Head of Surveillance Henny Brunekreef has been supervising the security project on behalf of Ede town council. "We have to supply the material, so that means we are responsible for its quality. That's why we placed high demands on our supplier. After all, modern problems need to be tackled with modern techniques."

Privacy

Ede is the first town in the Netherlands which has been given permission from the Registration Board to record its video pictures. The pictures are kept for 24 hours, and because of privacy regulations, the management of the tapes is in the hands of the town council itself. VCS has assisted Ede town council in coming to agreements with the Registration Board.

PMS Monitoring Codec

– Remote Surveillance by ISDN

The New Wave in preventative crime surveillance

Security is essential to all organisations but none more than banks. With cash dispensers throughout the world needing surveillance around the clock, security requirements are pushed to the limits. That's why German bank giant, The Norddeutsche Landesbank, has installed monitoring Codecs in several of its branches. It's a system developed by Sony that gives multi-site two-way surveillance from a single central location. And by using the latest ISDN technology it's possible to prevent crimes as and when they happen.

The decisive plus point for the Sony Picture Monitoring System (PMS) is the fact that it provides fast, efficient two-monitoring. The system can be self-activated by movement or alarm which means surveillance only when there is activity at the locations – no time is wasted watching empty spaces. And it is possible to operate each individual camera (pan, tilt and zoom) and intervene directly to prevent crime happening from a central control room.

Rainer Hannich, responsible for central security at The Norddeutsche Landesbank explains how the PMS works in practice: " A hidden camera transmits live pictures from each cash-dispenser foyer via an ISDN cable link to a central control point which is continually manned. If undesirable activities are observed at a certain location, the operator at the central control point is alerted to it and can address the persons concerned directly via an intercom. If there is no reaction, the local police are called. All the events related to the crime are subsequently recorded for evidence. In this way, for the first time ever, there is a surveillance system that can do more to prevent crime than simply being a visible deterrent."

Sony provides CCTV Facilities for Expo'98 in Lisbon

Expo'98 in Lisbon, Portugal, a truly global event: the organisers started with a near abandoned site in Lisbon's port district and rejuvenated the whole area, building an exhibition site of some two million square metres. In four months, a total of 10 million people visited the exhibition, a figure that is larger than the entire population of Portugal. The highest attendance was achieved on Expo's last day when over 380,000 visitors passed through the site.

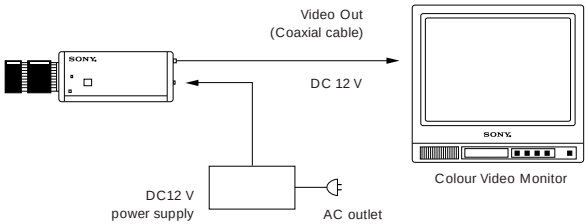
In this environment surveillance and security are critical issues. Sony proposed, installed and maintained a turnkey solution. To assist in the day-to-day operation, the manufacturer called in one of its specialist CCTV dealers in Portugal as well as an expert systems integrator.

Sony installed a network of 43 high-performance surveillance cameras, all with pan & tilt capabilities suited to outdoor operation. The monitoring centre had at its heart a control and switching system based on the new Sony CSP-5000 matrix and a total of 24 Sony CCTV colour monitors. In addition to the new equipment, the system also incorporated 14 existing monitors and two large screen displays. As well as the feeds from the 43 cameras, there were an additional eight camera feeds from a surveillance system in one of the private pavilions.

The network of cameras was connected to the control room using more than 60km of copper wire and 10km of optical fibre. All the images entering the control room were fed in to three Sony matrix keyboards. These pictures were relayed to another control room where the security department's controller could watch all the public areas on six Sony monitors. As well as watching all the pictures, the controller selected which images were sent to four colour monitors sited at the local Police station.

The entire network was installed by Sony in less than three months. Despite daily temperatures of up to 43 degrees Celsius, the system never failed during the four month period of Expo'98.

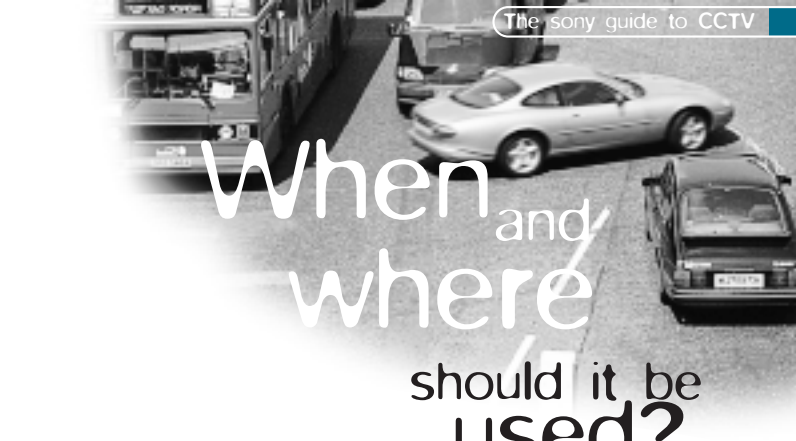
What
is Closed Circuit Television?



Closed Circuit Television (CCTV) is a television system which operates on a 'closed loop' basis. Unlike broadcast television, which is available to anyone with a suitable receiver, CCTV pictures are only available to those directly connected to the loop.

CCTV was first used in the 1950s and has since become an essential element in any professional security system.
In most installations, the loop is a physical link – a cable which carries the picture from the camera to the viewer. With very few exceptions, the pictures are transmitted as a composite video signal at 75ohms, 1 volt peak-to-peak. Where very high resolution (>400TV lines) is required, some equipment offers a Y/C facility where the luminance signal (Y) and the chrominance (C) is divided. Over long distances, for example in Town Centre systems, fibre optic transmission has become popular. Where this option is too expensive, ISDN offers a cost-effective alternative for event-driven surveillance systems.
As well as the full range of property protection and control applications, CCTV offers benefits in many other areas, for example:

- Assisting police authorities in the monitoring of traffic flow and the implementation of prompt action in case of accidents and other emergencies
- Supporting process industry managers as they control the flow of work, identify production bottlenecks and take corrective action
- Monitoring of hostile environments that are not accessible to man, i.e. nuclear reactors, furnaces, etc.



When and where should it be used?

Security and surveillance are the most accepted applications for CCTV systems. With the use of CCTV, managers and supervisors can control risks and minimise costs efficiently and with the minimum of disruption.

Security applications
As well as acting as an effective deterrent, CCTV helps managers to monitor:

- Access to secure areas
- Unauthorised activities
- Theft or criminal damage
- Personal safety

Surveillance applications
CCTV has many applications in public safety:

- Traffic control
- Alarm Verification
- Crowd control
- Insurance claim assessment
- Public access
- Staff control
- Car park security
- Shopping precinct security
- Industrial process control

Benefits
CCTV offers increased efficiency and the faster detection of problems. As a result, its benefits include:

- Reduced security running costs
- Faster response to problems
- Increased peace of mind
- Simplicity and reliability
- Improved quality of environment for owners, operators and the public
- Easier identification of suspects
- Increased management control

LIGHT

The human eye and the camera lens operate on completely different lines. Although the human eye adjusts automatically to various light conditions, the camera is inherently less flexible.

In a CCTV system, lighting has to be 'designed in' from the beginning if the best results are to be obtained. The type of lighting used, and the correct positioning, are vital to maximum security.
Everyday 'white light' is actually a mixture of colours of different frequencies. CCTV is more receptive to certain colour combinations than others. The best results are usually obtained by matching the spectral response of the camera to the light illuminating the scene. The amount of light reflected from an object determines how 'bright' it appears. Some typical reflective figures are shown below.

These figures relate to the minimum level of lighting required for security purposes to every day light. It can easily be seen that today's CCTV technology will give good results under very low light levels. Sony 'Exwave' cameras can operate in colour as low as 0.8Lux (F1.2) without switching to monochrome or reducing frame rate.

Asphalt	**5%**
Foliage	**10-20%**
Concrete	**25-30%**
Red Brick	**35%**
Snow	**95%**

	Lux*	DESCRIPTION
	50.000	Summer sunshine
	5.000	Overcast sky
	500	Well lit office
	300	Minimum for easy reading
	50	Passageway / Outside working area
	15	Good main road lighting
	10	Sunset
	5	Typical side road lighting
	2	Minimum security risk lighting
	1	Twilight
	0.3	Clear full moon
	0.1	Typical moonlight / cloudy sky
	0.001	Typical starlight
	0.0001	Poor starlight

* Metric unit of measurement of light

Backlight Compensation

It is also important to consider whether there are bright spots in the picture such as car headlights which can make identification of the vehicle registration or model impossible. This can also be a major problem where it is necessary to identify persons who are moving from bright daylight into artificial light. Very often this will result in the subject becoming an unidentifiable silhouette.

The problem is exacerbated where bright spots in the images cause vertical smearing. The answer is to specify a camera which has effective backlight compensation.

This can be operated automatically by Smart Control within the camera or, where the position of the subject is pre-determined, can be preselected.

It is helpful to be able to see how effective the backlight compensation is before making final camera selection.

Choosing a camera

The camera is the 'eye' of a CCTV system and at its core lies CCD (charge coupled device) technology.

The CCD is comprised of about 500,000 light sensitive cells called picture elements (pixels) which convert the light falling onto its surface into an electrical signal. The performance of the camera, and ultimately the surveillance system, is more dependent upon the quality of the CCD than any of the other camera components. Currently, the popular formats are:

Half-inch	High performance for high sensitivity and low noise
Third-inch	Most popular and ideal for a wide range of applications
Quarter-inch	A more recent development

Benefits of CCD Technology

Long Life	Produced with a design life of up to 10 years
Shock Resistant	Much more rugged than older tube technology
Size and Weight	Have enabled the miniaturisation of cameras
Spectral Response	Responsive in the near infra red area

Pixels (Picture Elements)

Total Pixels	This is the total number of pixels on the CCD faceplate. They are not all usable
Active Pixels	This is the real figure giving the number of pixels that are actually in use

Sensitivity

Colour cameras generally perform less well in low light than monochrome cameras, all other things being equal. Sensitivity is usually measured by reference to the lux level at which a camera can produce an image (see page 9). The lux valuation, although usually referred to as a metric unit of measurement of light, is very often applied subjectively to the ability of a camera to produce images. Comparisons based on the lux levels given by different manufacturers do not usually lead to a valid determination. A more valid comparison can be made where the F-stop of the lens is also quoted together with the video level, although the best solution is to make a live visual evaluation of the cameras under consideration.

1 Lux level at the face plate
This measures how the camera performs when all light falls directly on the chip faceplate. Whilst technically valid, this never actually happens. You cannot get a picture unless you use a lens and the lens cuts down the available light.

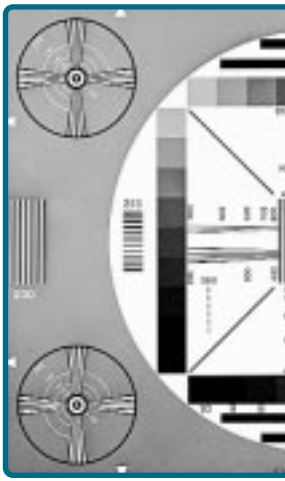
2 At the lens
This is closer to the specification we are looking for because it goes some way to describing the specification in real life.

Which lens ?

The lower the 'F' number of the lens used the better the result. For example:

- Camera one quotes 0.8 lux full video with an F1.0 lens
- Camera two quotes 0.8 lux full video with an F1.2 lens

Camera two is the more sensitive camera as it quotes 1 lux with a slower F1.2 lens. With the faster F1.0 lens, it would probably give a full video signal at only 0.6lux.

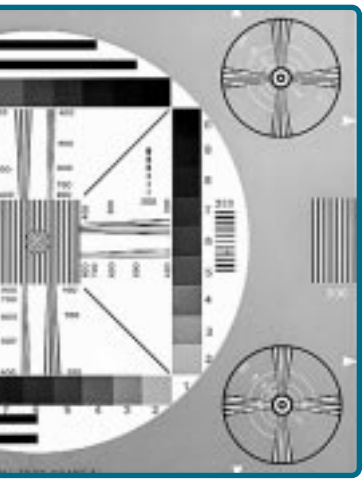


Colour Rendition

Any assessment of a camera's operating capabilities should include how accurately it can reproduce colour. If, for example, a target subject is dressed in a brown jacket and blue trousers it will not be helpful for the police if they are looking at a CCTV image of a person apparently wearing an orange jacket and turquoise trousers. This will also have severe limitations on the evidential value of such an image. Cameras offering better colour rendition will have both auto and selectable white balance to handle varying lighting conditions.

Camera Resolution

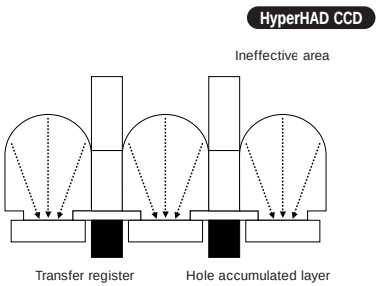
The higher the resolution the sharper the picture. The best resolution available at present for CCD cameras is approaching 750 horizontal lines (TV lines) (3-CCD, DXC-950P) and 500 vertical lines.
Resolution is not necessarily the key decision point. Low resolution CCTV, which is usually lower cost, is often perfectly adequate and the final choice depends on the combination of camera features and build quality together with site conditions and available funds. As a general rule, a high resolution is preferable in low light levels and when identification of points of fine detail are required.

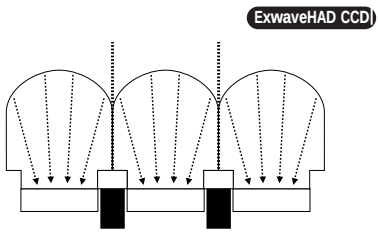


Sony ExwaveHAD Technology

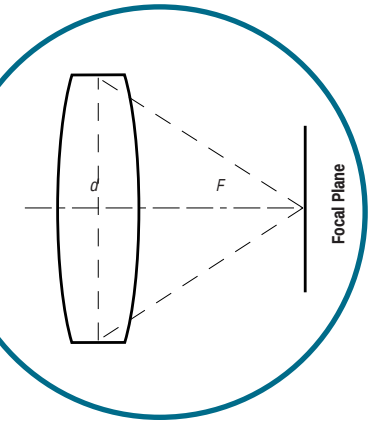
A key question to consider is whether colour or black and white cameras should be selected. Not many people now watch black and white television in their homes – a colour picture is easier to interpret, provides more information and is more natural than a monochrome one. In surveillance applications, the split currently between colour and monochrome is about 50/50.

In recent years, the price difference between the two has diminished. The principal limiting factor against the use of colour cameras has been the ability of colour cameras to operate effectively in poorly lit areas.
To meet this demand for colour images in low light, manufacturers have developed a range of solutions, the most popular of which include hybrid cameras that operate in colour when lighting is adequate, switching to monochrome as darkness falls. Some cameras operate in low light by reducing the number of frames captured to produce a brighter picture although this causes problems when there is movement within the image.
Sony has developed a more radical approach by improving the sensitivity of the CCD chip. On Chip Lens technology (OCL) increases the surface area and sensitivity of the CCD by locating a microlens on each pixel which results in more light being collected on the photosensitive layer. This technology has been developed most recently with the introduction of the ExwaveHAD CCD which has a highly advanced OCL structure. The result of these developments is a degree of sensitivity that can handle twilight light levels while still producing accurate colour images even with rapidly moving objects.
Smear is caused by the leakage of light onto the vertical shift register, creating a vertical bar across the image which can render it useless and is a common problem with cameras in low light or where there are bright spots in the picture.
With ExwaveHAD, this leakage is reduced because the improvement in the structure of the CCD minimises the undesirable reflection of light onto its surface. As a result, smear is reduced to a minimal level of -120dB – comparable to the frame interline transfer CCDs commonly used in broadcast cameras. Sony now produces both colour and monochrome cameras which benefit from the advanced technology of ExwaveHAD technology.





Selecting the Correct Lens



Basic Lens

F = Focal Length

d = Lens Diameter or Aperture

f = Lens Stop Expressed as a ratio of Focal Length to Aperture

$$f = \frac{F}{d}$$

The quality of the lens is vital in determining the quality of the final image. The basic optical characteristics of a lens are the focal length (in zoom lenses the focal length range) or angle of coverage, and the aperture range. We'll look at these two characteristics together with a third important characteristic, the format.

Focal Length (F)

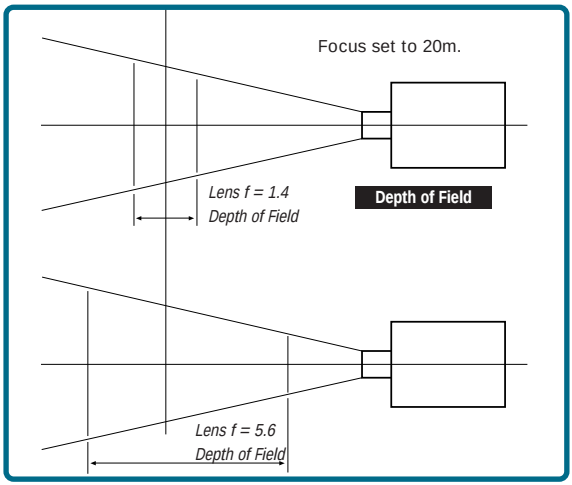
The focal length represents the distance from the optical centre of the lens to the point at which the image is in sharpest focus and where the pick-up device in the CCTV camera is located. The focal length determines the angle of coverage of the lens. The longer the focal length, the narrower the angle of coverage and the shorter the focal length, the wider the angle of coverage. One particular angle of coverage produces a picture very similar to that seen by the human eye. A lens giving this angle is called a 'normal' lens. The focal length of a normal lens is approximately equal to the diagonal of the picture area. For example, for a 2/3 inch camera, the normal lens would have a focal length of 16mm. A 1/2 inch camera would have a normal lens of 12.5mm and a 1/3 inch camera, an 8mm normal lens.A focal length shorter than a normal focal length produces a wide angle view. A longer focal length produces a telephoto image. Some lenses have variable focal lengths and are called zoom lenses.

Aperture range
The aperture is the clear opening in the centre of the lens that allows light to pass to the pick-up device.
The aperture size is described in relation to the focal length (F). Thus the aperture is specified by an F number. If the lens has a focal length of 50mm and if the diameter of the clear opening of the lens is 25mm, then the lens is said to have an aperture of F:2 (50mm divided by 25mm = 2). A 50mm lens with an aperture of F:2 has the same light gathering ability as a 150mm F:2 lens but the glass components will be more complex in order to achieve the telephoto effect.
Most CCTV lenses have a built-in mechanism called an iris. This allows the aperture to be changed to accommodate varying light levels. The largest aperture setting is often used to define the maximum light gathering capability of the lens, the lens speed. A lens with a maximum aperture of F:1.6 is referred to as an F:1.6 lens and is said to be 'faster' than, say, an F:4.2 or F:8 lens.The iris setting of the lens is numbered from the largest F stop down to the smallest F stop. CCTV systems are rarely installed in situations where light levels are constant, so lenses with automatic iris adjustment are important components of most systems.
Another characteristic of lenses is the 'depth of field' (see illustration). If a lens is focused on an object there will be a certain area of sharp focus in front of and behind the object.
The depth of this area of sharp focus is controlled by three factors: the focal length of the lens, the distance from the lens to the object and the F stop.

Lens Format
The lens format relates to the camera format, 1/3 inch, 1/2 inch, 2/3 inch. There are two lens mounting systems. Most CCTV cameras have a 'C' mount, although many now use a 'CS' mount. 'C' mount cameras are not able to use 'CS' lenses, however adaptors are available.

To avoid the complexities of lenses with automatic irises, manufacturers have developed 'electronic shutters'. These achieve the same light adjustment with simpler, fixed iris lenses. The CCD iris common to most Sony CCTV cameras automatically controls image exposure by electronically adjusting the incoming light levels.

Cameras with Built-in Lens
Some cameras are now available with a built-in lens. Sony manufactures a 1/3 inch colour camera with an integral 5.4mm – 64.8mm zoom lens (SSC-CX34P) which can be used in place of the conventional camera and motorised lens set-up.
This saves installation time and the resultant set-up is lighter, allowing the use of more compact camera housing and pan and tilt head.



Which Monitor?

A control room operator may be required to view images on a bank of monitors for prolonged periods. As the effectiveness of the surveillance system is crucially dependent upon the degree to which the operator can remain alert and avoid fatigue, correct monitor selection is vital.

The monitor converts the video signal generated by the camera back into a visual image. It consists of a cathode ray tube (CRT) and a number of signal processing circuits.
These circuits separate the 'luminance' part of the signal from the 'sync signals'. The luminance signal is routed to an amplifier, which boosts the signal to a level that can be used by the CRT. The sync signals are split onto horizontal (H) pulses and vertical (V) pulses. These in turn are amplified and modified so that they can control the vertical and horizontal deflection of the final picture.
Where the video signal is being looped through the monitor to another piece of equipment (for example, another monitor or video recorder), it is important to ensure that the system is correctly terminated. Some monitors will do this automatically, but others have a switch located at the rear.
This should be set according to whether the signal is being looped out of the monitor – High Impedance – or is terminating, in which case it should set to 75 ohms.
The last item of equipment in the system should be set to 75 ohms if it does not auto terminate.
Video signals usually travel over coaxial cable, which has impedance of 75 ohms. The best and most efficient transfer of the video signal from camera to monitor is when the camera, cable and monitor all have all the same impedance values.
Contrast levels can be improved where a DC clamp facility is incorporated into the monitor. This can usually be selected via a switch at the rear of the unit.

Monitor sizes
Monitor size is designated by the length of a diagonal line measured from one corner of the viewing screen to the opposite corner. Thus a 9-inch monitor refers to a 9-inch diagonal picture tube. Sizes typically used in CCTV include 9, 12, 14, 17, 21 and 27 inches with different manufacturers offering different variants.
The choice of size depends in part on the distance between the viewer and monitor.
CCTV monitors may be free standing, suspended from a wall or

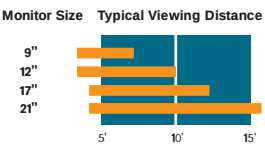
ceiling, or rack mounted. Wall and ceiling mounts allow the monitor to be rotated and tilted for viewing from different angles.

Monitor costs

Why does a 17-inch black and white CCTV monitor cost more than the equivalent black and white TV? The answer is that the CCTV monitor has specialist features and characteristics. For example, the average TV set has around 300 lines of resolution while the CCTV monitor would normally have over 700 lines. The CCTV monitor also has regulated power supply to maintain performance during power fluctuations, an isolation transformer and a fast acting automatic frequency control (AFC) loop to reduce radio frequency interference.

Colour monitors

Colour monitors are also available in a similar range of sizes. These monitors usually accept only composite colour signals, although where very high quality images are required, monitors with a Y/C (luminance and chrominance) input should be used. Two principal types of colour CRTs are currently in use: the shadow mask CRT and the Trinitron. The face of the shadow mask type is based on the shape of a sphere, whereas the Trinitron is based on the shape of a cylinder. This means that the Trinitron is curved only in the horizontal plane providing an image which is more geometrically accurate and which reduces operator eye-fatigue caused by reflected light from above. Close examination of the shadow mask CRT reveals how the image is constructed from dots or ellipsoids whereas the Trinitron images consist of continuous stripes resulting in a cleaner and more stable image.



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Transmission of Video Signals

A CCTV signal contains a wide range of frequencies from around 30 hertz to around 10 Megahertz. As a result special circuits are required to cope with the wide band-width if signal quality is to be maintained during transmission.

Because signals from CCTV cameras often have to travel long distances to reach the control centre, the choice of transmission medium depends upon the particular installation and its requirements.

Coaxial Cables

The most widely used cable is the coaxial type. It should have characteristic impedance of 75 ohms and be of a high quality. The cable consists of an 'inner' solid copper conductor or twisted copper wires surrounded by a flexible insulating material such as polythene. It is recommended that for CCTV a solid polythene type coaxial should be used to give maximum high frequency performance. The 'outer' conductor consists of a copper braid wound around the insulation. To protect the cable from moisture and damage, it is covered with a tough PVC sheath. Sony CCTV cameras can be powered via the Triple Multiplex transmission system, to ensure maximum ease of installation. With this system, the video signal from the camera, the sync signal and the DC power are all supplied via a single coaxial cable. The Sony system also allows for cable lengths of more than 600 metres without any loss of image quality.

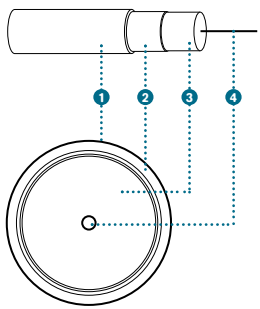
Twisted Pair

An alternative to the use of coaxial cable is the 'twisted pair cable'. A twisted pair cable is known as a 'balanced' cable and can be similar to telephone wires. Most of the same considerations apply to twisted pair as apply to the coaxial but there are some expectations. The twisted pair system will accept the standard 75 ohms, 1 volt composite video signal and convert it to a balanced video signal of 2 volts with an output impedance of 50 to 150 ohms to suit the particular twisted pair being used.

The approach is relatively inexpensive and can transmit over longer distances than conventional coaxial cable. The major disadvantage is that transmitter and receiver units are required for every video signal source. This is because units such as

monitors which process base band video signals will not accept the balanced twisted pair type of transmission.

Coaxial Cable



1 P.V.C. Outer Protective Sheath
2 Braided Copper 'Outer' Screen
3 Polythene Insulation
4 'Inner' Copper Conductor

Fibre Optics

Fibre optic transmission of video signals is now widely used within the CCTV industry, most particularly on large projects such as town centres. Optical fibres are fine strands of glass with a high quality of optical transparency which act as wave guides for light beams. They have lower transmission losses than conventional cables and are virtually immune to electrical interference.

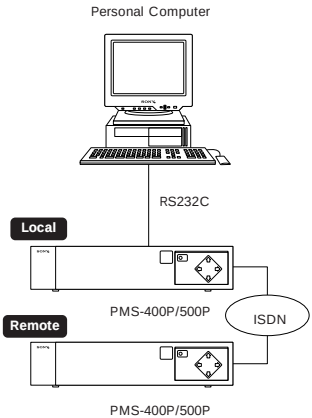
Developments in laser technology have made optical fibre a useful means of video transmission. The video signal modulates the laser beam, which is then transmitted through the fibre. Picture quality remains excellent over distances greater than 50km.

ISDN Transmission

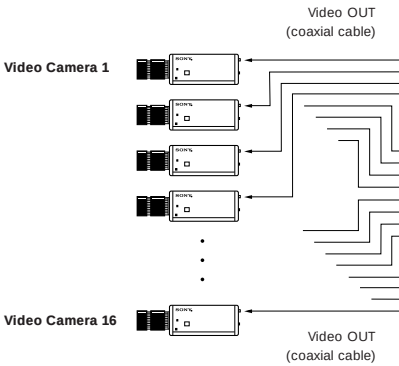
An increasingly popular method of transmitting video signals is to use ISDN. This is a digital phone line which transmits video signals at 128 kilo bits per second.

The signals are encoded at site, transmitted across the telephone network, and then decoded at the monitoring centre. These systems are event driven which means that they only transmit video when an event has occurred – for example a break-in at a property activates a PIR which then causes the transmitter to dial the monitoring centre which can then take appropriate action.

These systems do not provide live video images because of bandwidth constraints but some systems, like the Sony PMS-500 Codec, can transmit up to 15 frames per second. The PMS-500 can also transmit and receive full duplex audio, together with data signals for control of telemetry and other remote devices via the RS232 and RS485 communication ports.



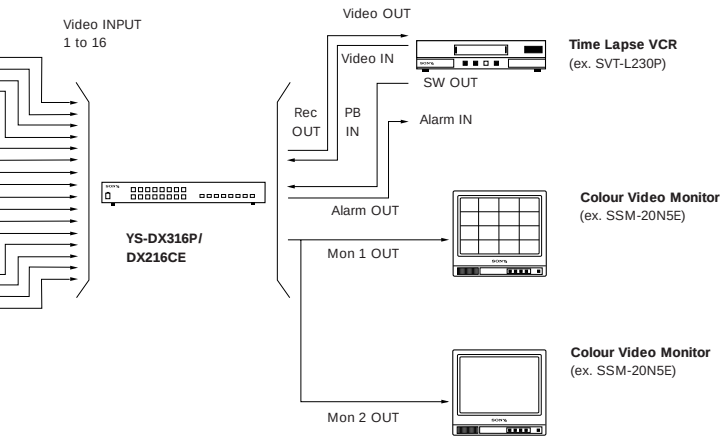
These devices facilitate a flexible range of applications and are increasingly being manufactured to international standard, H.320 (ITU-T recommendation).



Video
Switching and Multiplexing

If a system consists of a single camera and monitor, then a switching device will not be required. It would not, of course, be practical or desirable in a multi-camera system to have a monitor for every camera. In these cases, a switcher will enable the video signal from several cameras to be viewed on just one monitor.

Switchers.
Manual switchers are the most basic form. Here, the operator selects the camera they wish to view. Automatic switchers are the most popular versions. These run a sequence of displays in the order that the operator selects. The operator can also hold one particular camera if he wishes to observe some relevant activity, can skip channels if they do not at that time require monitoring, and adjust the dwell time for each camera. Automatic switchers also normally have an alarm programming option which can override any manual settings.



Multiplexers

Multiplexers are a more functionally useful way of handling a multi-camera system. Like a switcher, several cameras (usually up to 16) can be connected to the multiplexer. A single field or frame from each camera is successively output via the multiplexer onto a video recording. Playback would take place again via the multiplexer which would decode the recording to the monitor.

So, for example, if four cameras were connected to the multiplexer, on playback, the particular camera to be reviewed would be selected and an updated image produced every 0.87 seconds (Sony YS-DX316P and SVT-5050P). The more cameras that are recorded onto one tape, the fewer images per camera are captured – if eight cameras were connected, that refresh rate would extend to one image every 1.73 seconds.

In the majority of cases, these types of refresh rates provide sufficient information to enable incidents to be reviewed effectively. Problems may arise if the video recorder is a time-lapse machine recording many cameras over long periods. For example, if 16 cameras were recorded over 72 hours you would have to wait 9.87 seconds for the image from each camera to be updated. It is therefore important to ensure that an acceptable ratio of cameras to multiplexers/VCRs is utilised.

Duplex multiplexers can display in multi-picture mode at the same time as recording, as above. Simplex multiplexers can either record or display, but cannot do both simultaneously.

CCTV Systems Control

While the majority of cameras are installed in a fixed position, in order for the operator to be able to follow an incident it can be very useful to have the facility to pan, tilt and zoom the camera.

This is achieved by the use of a mechanical pan and tilt head on which the camera is mounted and a zoom lens which are controlled remotely by telemetry signals. As in most instances the camera will be fitted outdoors and therefore it will be necessary to use a housing which will protect it from the elements or to use a dome camera.

Telemetry
There are two types of electronic telemetry: one uses a twisted pair, where long distances are involved; the second uses coaxial cable – in fact, the same cable that carries the video signal. The basic form of telemetry control system uses digital techniques to produce a pulse code modulated (PCM) signal. This is a signal which has a series of 16 pulses and, depending upon the function required (pan/tilt or zoom), sends the appropriate pulses to a receiver which interprets them and carries out the function.

Housings and Enclosures
These protect the CCTV camera/lens assembly. Used in both internal and external applications, housings also protect against dust, vandalism and extreme weather conditions.
Many different housings are available with accessories, such as thermostatically controlled viewing windows, sunshields, blowers for hot environments and heaters for use in extreme cold.

Domes
Domes operate in much the same way as a conventional pan, tilt and zoom camera except that they are generally more compact and have the added advantage of being discreet – both aesthetically and for the purpose of surveillance. It is not usually possible to see in which direction the camera within the dome is directed. Conventional housings score over domes in terms of robustness and there is less chance of the optical distortion created by the spherical dome cover.

Recording

While a proportion of surveillance systems are continuously monitored, these are in the minority. The majority of systems are not actively monitored and, even when they are, in most cases, the images are still recorded.

The underlying principle to be considered in relation to the recording of images is that they may ultimately be required as evidence in criminal proceedings. Despite sometimes poor quality recordings, many spectacular successes have recently been achieved in the detection and conviction of serious offenders, thanks to the existence of recording material.

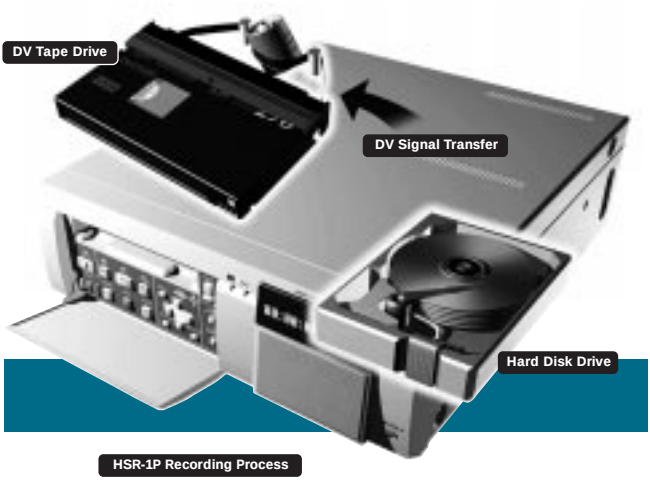
Analogue Recording
The preferred medium for recording and storing activity has been, and still is, VHS videotape, usually recorded on a time-lapse video cassette recorder (VCR). These machines are very similar to domestic video recorders but have extended record and playback facilities, time and date encoding and alarm inputs.
The extended recording facility is achieved by reducing the frequency of fields that are recorded, thereby extending the recording period of the tape.
The number of fields is further reduced when the VCR is recording multiple cameras from, for example, a multiplexer.

VHS VCRs record around 300 TV lines horizontal resolution in monochrome and 240 TV lines in colour. The requirement to record higher resolution images has led to an increase in the use of Super-VHS VCRs which record about 400 TV lines. These are recommended where it is intended to record vehicle registration numbers or other fine points of detail.
VCRs have many moving parts which require regular service to maintain performance. For this reason, it is recommended that VCRs are serviced once a year.

Digital Recording
Increasing demand for higher quality, more flexibility and lower maintenance has encouraged manufacturers to develop recording equipment which more closely matches the needs of surveillance systems. This new technology is based on digital processing and storage and, in most cases, produces higher quality images than analogue systems. Greatly increased storage capacity also allows higher picture refresh rates and selectable resolution modes. Camera inputs are multiplexed, stored on a hard disk and, periodically archived to Digital Video (DV) tape. Resolution modes of up to 500 TV lines can be accessed which are simply not possible on conventional analogue VCRs.

The evidential value of digital recording has been considered in the UK by the distinguished committee of Law Lords who have concluded that the same procedural requirements which apply to analogue recording are also applicable to this more recent technology.

Video Printers
A useful part of larger systems – a printer can produce hard copy images either from live or recorded cameras.



HSR-1P Recording Process

Sony CCTV Products

COLOUR CCD CAMERAS

SSC-DC50/54/58AP
ExwaveHAD, half-inch, 470 TVL, 0.8Lux

SSC-DC330/334/338P
ExwaveHAD, third-inch, 480 TVL, 0.8lux

SSC-DC10/14/18P
Third-inch, 470 TVL, 1.7Lux

SSC-C104/108P
Third-inch, 330 TVL, 1.2Lux

SSC-CX34P
Third-inch, 470 TVL, c/w 12x motorised zoom lens

MONOCHROME CCD CAMERAS

SSC-M370CE
Half-inch, 570 TVL, 0.3Lux

SPT-M304/308CE
Third-inch, 570 TVL, 0.25Lux

SPT-M320/324/328CE
ExwaveHAD, third-inch, 570 TVL, 0.07lux

SPT-M122/124/128CE
Third-inch, 380 TVL, 0.1Lux

COLOUR VIDEO MONITORS

SSM-14N5E
Trinitron,14-inch, 600 TVL, Y/C and audio

SSM-20N5E
Trinitron, 20-inch, 600 TVL, Y/C and audio

SSM-9040P
Trinitron, 9-inch, 250 TVL

MONOCHROME VIDEO MONITORS

SSM-930CE
9-inch, 750 TVL, DC clamp

SSM-125CE
12-inch, 750 TVL,
DC clamp and dual inputs

SSM-175CE/175 ACE
17-inch, 850 TVL, DC
clamp and dual inputs

MONOCHROME QUAD MONITORS

SSM-Q177CE
17-inch monitor with built-in
quad switcher, 850 TVL

TIME-LAPSE VIDEO RECORDERS

SVT-124P
24-hour compact VHS

SVT-1000P
72-hour VHS, RS-232C option

SVT-L230P
72/96 hour VHS, 'RealAction', RS232C option

SVT-5050P
960-hour VHS, RS232C option

SVT-S3050P
168-hour Super-VHS, RS-232C option

SVT-RS1A
RS-232C Interface Board

SVT-RM10
Wired Remote Control

TPK-Series
10,000 hour service kits for all VCRs

ISDN TRANSMISSION

PMS-500P
Transmitter/receiver codec

PMS-400P
Transmitter codec

PMS-CENTRAL
Remote monitoring Control Software

DIGITAL SURVEILLANCE RECORDER

HSR-1P
DV-based, up to 6,480,000 image storage capacity, built-in 4 channel multiplexer

HSRA-11
Optional 4 channel input board

MULTIPLEXERS

YS-SX210CE
Mono, simplex, 10 channel

YS-SX310P
Colour, simplex, 10 channel

YS-DX216CE
Mono, duplex, 16 channel

YS-DX316P
Colour, duplex, 16 channel

QUAD

YS-Q440P
Colour, 4 channel

SEQUENTIAL SWITCHER

YS-S6
6 channel

Basic CCTV Terminology

AGC
Automatic Gain control. Usually a switchable circuit that allows the camera to provide a 'useable' picture during low light levels. You can generally tell when the circuit is operating because the picture appears to be 'grainy'.

AMBIENT LIGHT
Lighting level that is normal for a certain area. It generally does not alter. It also can mean the background light level of a certain area.

APC
Adaptive Picture Control. VCR function which automatically detects the condition of the recording head and the video tape and then sets the optimum record head current to prevent over-modulation.

APERTURE CORRECTION
Switchable correction circuit which sharpens the image of a picture electronically.

AUTO IRIS
Causes the aperture of a lens to automatically adjust to varying light levels, thus providing a constant picture.

BALANCING LINE
A circuit for transmission of video signals which are equal in voltage, but of opposite polarity.

BANDWIDTH
A value which expresses the difference between the upper and lower limits through a range of frequencies.

BLACK LEVEL
A measurement of a video signal that matches a specified maximum limit for black peaks in the picture.

BNC
Commonly used video connector for composite video.

C MOUNT
The industry standard type of screw threaded lens mount.

CCD
Charge Coupled Device. The latest technology for imaging devices. There are two main types: Interline transfer and Interframe transfer.

CCTV
A Closed Circuit Television System which is for private purposes only, and not for public or general broadcasting.

CODEC
Short for coder/decoder. An ISDN transmission system designed to the international teleconferencing standard, H.320.

COMPOSITE VIDEO
1. A video signal in which the luminance and chrominance components have been combined (encoded) as in NTSC, PAL or SECAM.
2. A video signal obtained by combining parts of at least two video signals, for example by keying or matting.

CONTINUOUS STRIPE PHOSPHORS
Method employed within Trinitron monitors to increase brightness and resolution over conventional dot pattern CRTs.

CROSS TALK
Electrical interference caused by electromagnetic or electrostatic couplings from nearby conductors or external sources. It can also

refer to interference between two or more signals in close proximity within a bandpass.

CRT
Cathode Ray Tube. Means by which the picture is displayed on a monitor.

CS MOUNT
Same thread as C-mount.

DARK CURRENT
Leakage signal from a CCD sensor in the absence of incident light.

DARK NOISE
Noise caused by the random nature of the dark current.

dB
Decibel, a ration of input power. It is also a measurement of sound levels.

DEPTH OF FIELD
The distance between the furthest and nearest points at the same level of definition within a certain view.

DIGITAL VIDEO
A video storage media using 5:1 compression method.

DWELL TIME
Amount of time that a sequential switcher allows between the viewing of the different cameras connected to it.

ELECTRONIC SHUTTER
CCD iris which eliminates the need for an auto iris lens. The CCD iris automatically controls the light intensity by adjusting the electronic shutter speed.

ExwaveHAD
Trademark of latest Sony Hole Accumulated Diode charge coupled device.

F STOP
Figure given of the ratio between a lens aperture and its length.

FOCAL LENGTH
Distance froÂm the optical centre of a lens to the focal plane. Generally referred to in millimetres.

FOCAL POINT
Point at which light passing through a lens is concentrated.

FRAME
A single television or film image. In European television, 25 frames per second is used to give an illusion of continuous movement. Each frame in TV is normally two fields.

GAMMA
Unit of measurement for one amount of contrast in an image.

GENLOCK
A means of locking a video source to a second video source or reference signal.

GROUNDLOOP
A condition that occurs when two or more grounded points in an electrical system develop a conductive loop between them.

HAD SENSOR
An improved type of semi-conductor sensor which gives cameras a better smear and noise performance.

HDR
Hard Disk Recorder. A device which captures images to hard disk.

HSR
Hybrid Surveillance Recording. A combination of hard disk and Digital Video in one recording machine which greatly increase the storage capacity over HDR.

HyperHAD
An improved version of the Sony HAD sensor, using on-chip lens technology to provide increased sensitivity.

IMAGE INTENSIFIER
Device which uses photo multiplier technology to amplify the available light to increase the sensitivity of a camera.

INFRA-RED
A range of frequencies just below the visible spectrum. Can be used for the transmission of information or for providing additional illumination for cameras.

INTERLACE 2:1
Scanning process for reducing the image flicker consisting of successively scanned lines which adjacent lines belong to different fields.

ISDN
Integrated Services Digital Network. Digital phone line with transmission speeds of up to 128Kb per second. Used with PMS video transmission systems.

LINE FED CAMERA
See Triple Multiplex.

LINE LOCK
Method of synchronising AC powered cameras.

LUX
Metric unit of measurement of light.

MECHANICAL FOCUS
Focusing of a camera lens or pick-up device by mechanical means.

MEGASTREAM
A network (normally fibre optic) allowing the transmission of data at 1Mbits per second or faster.

MONOCHROME
Black and white picture comprising of a number of levels of grey scales.

MULTIPLEX
Method of transmitting or recording many video signals at the same time.

ND
Neutral Density. Filter which is positioned on the rear of the lens, enabling the camera to operate in difficult lighting conditions, by widening its operating parameters.

PEAK TO PEAK
Value between the maximum positive and negative points on a waveform

PIXEL
A word derived from Picture Element. This is the smallest unique point of digital video image. In digital video, a picture is divided up into thousands of Pixels, each specified by luminance, chrominance and position information.

REAL ACTION RECORDING
High density VCR recording which provides three times as many fields as conventional time-lapse VCRs.

RESOLUTION
The definition of a TV picture in terms of the finest detail that can be recorded and played back.

RS232/485
Serial Interface commonly used to communicate between different control equipment.

SEQUENCE SWITCHER
A switcher that displays camera pictures in a set order and dwell time, predetermined by the user.

SMART CONTROL
Developed by Sony in 1994, this digital technology allows Sony cameras to automatically adjust iris, gain, white balance and flicker to external lighting conditions.

SPECTRAL RESPONSE
This is the response of the light sensing (charge coupled) device to different wavelengths of light. Typically between the ultra violet and infra-red spectrum.

SUPER-VHS
VCR recording system that enables recording of 400 TV lines horizontal resolution as compared with ordinary VHS of 240 TV lines in colour.

SYNC GENERATOR
Device that produces a synchronisation signal.

TELEMETRY
Electronic method of controlling functions, such as pan, tilt, zoom, focus, generally via coaxial cable or a twisted pair of fibre optic.

TIME LAPSE
Video cassette recorder which allows the compression of real time recordings onto tape using time lapse mode. Can be up to 960 hours onto a single hour tape.

TRINITRON CRT
Cathode Ray Tube which is completely flat in the vertical plane to enable better monitor image geometry.

TRIPLE MULTIPLEX
A transmission of video, sync and DC power over a single coaxial cable.

VERTICAL PHASE
Feature on some AC cameras to adjust line lock and synchronise multi-camera system.

VHS
Video Home System. Domestic video recorder format giving 240 TV lines horizontal resolution.

WATERMARKING
Technical method of ensuring the integrity of images recorded digitally.

WHITE BALANCE
Term which only applies to colour cameras. Where white is the reference to determine all other colours in the visible spectrum.

Y/C
Method of separating and transmitting video signals divided into Chrominance C (colour) and Luminance Y (brightness) for higher resolution and quality. Usually employed between multiplexer/recorder/monitor.

ZOOM RATIO
Term where the lens has moveable elements. For example it is generally defined as 6:1 or 10:1 (i.e. 12.5 – 75mm or 10 – 100mm)

Notes

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SONY